METHOD FOR TREATING WASTE-ACTIVATED SLUDGE USING ELECROPORATION

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation-in-part of application serial number 10/107,614, filed March 26, 2002, which is incorporated by reference herein, which is a continuation of application serial number 09/612,776 filed on July 10, 2000, now U.S. Patent No. 6,395,176, which is incorporated by reference herein, which is a continuation-in-part of application serial number serial number 09/468,427, filed on December 21, 1999, which is a continuation of application serial number 09/229,279, filed on January 13, 1999, now U.S. Patent No. 6,030,538, which is incorporated by reference herein, which is a continuation-in-part of application serial number 08/934,548, filed on September 22, 1997, now U.S. Patent No. 5,893,979, which is a continuation-in-part of application serial number 08/552,226, filed on November 1, 1995, now U.S. Patent No. 5,695,650, which is incorporated by reference herein,.

BACKGROUND OF THE INVENTION

In U.S. Patent No.6,030,538, issued in February 29, 2000 entitled "Method and Apparatus for Dewatering Previously-Dewatered Municipal Waste-Water Sludges Using High Electrical Voltages, there is disclosed a system and method for dewatering and treating sludge emanating from municipal waste, or pulp-waste from a paper mill, as well as treating animal and plant waste. In that patent, the method for breaking down the sludge is to subject it to electroporation, which incorporates nonarcing, cyclical high voltages in the range of between 15 kv./cm

and 100 kv./cm. which break down inter-cellular and intracellular molecular bonds of waste-activated sludge (WAS), to thus release inter-cellular and intracellular water, whereby the WAS is rendered inactive and greatly reduced in mass.

The viability and effectiveness of pulsed electric field (PEF) for disrupting the biomass in waste activated sludge (WAS) derived from municipal wastewater treatment has been proven in laboratory testing and on-site pilot projects. While there was no significant increase in the solids content of dewatered sludge, the quantity of WAS needing disposal was estimated to be significantly reduced.

The pilot plant for testing at one or two wastewater treatment plants that generate WAS has been developed and deployed. A pulsed electric field (PEF) system that could handle 0.5 to 1.0 pgm WAS feed was designed. This requires an 8 kw power supply capable of generating 30 kV and pulse generator capable of handling 50 amp peak, current, bi-polar pulses, square wave, 10 μs pulse width, and 3000 pulses/second (pps).

SUMMARY OF THE INVENTION

It is also a primary objective of the present to provide a treatment of municipal sludge, paper-pulp sludge, animal and plant waste, and the like, whereby the treatment thereof via electroporation causes the breakdown of waste activated sludge, which is then cycled either back to a previous bioreactor, and/or to one or more additional bioreactors, such as aerobic, facultative, anoxic, or strictly anaerobic.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be more readily understood with reference to be accompanying drawing, wherein:

Figure 1 is a schematic showing the process for electroporating sludge in order to break up and destroy the waste-activated sludge for transport to one or more bioreactors.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, there is shown the schematic for using the PEF-electroporation system as a secondary treatment for previously-dewatered sludge. In Fig. 1, the primary-treated wastewater is delivered to a bioreactor 10, which may or may not be provided with air depending upon the type of bioreactor used, as described hereinbelow. The bioreactor 10 may be aerobic, facultative, anoxic, or strictly anaerobic. From there the sludge may be sent to an optional secondary clarifier 12, if necessary. From there, the sludge may be recycled directly back to the bioreactor 10. The sludge may be optionally thickened at thickener 16, with excess sludge being sent to a sludge dewatering unit 20 for further dewatering for forming a filter cake. From sludge dewatering unit 20, the filtrate is recycled back to the bioreactor 10. The filtrate exiting the bioreactor 10, either directly or through secondary clarifier 12 and thickener 16, is delivered to electroporating device 14, which provides a pulsed electric field (PEF) with voltages between 15 kv./cm. and 100 kv./cm., as disclosed in detail in the above-mentioned patents and applications. The waste-activated sludge (WAS) treated by the electroporation device 14 is broken up and destroyed, releasing intracellular and inter-cellular water, and organic

solids-contents. The PEF process is applicable to biomass contained in biological sludges from all the types of secondary wastewater treatment bioreactors. The PEF process is effective because it lyses cells, and the resulting cells become more readily available as food when those treated cells are fed to a bioreactor.

The PEF-treated sludge is then delivered to one or more bioreactors. It may be recycled back to the bioreactor10, to one or more optional bioreactors 22, or to both the bioreactor 10 and optional bioreactor or bioreactors 22. If delivered to optional bioreactor 22, the filtrate therefrom is transported to the sludge watering device 20.

The bioreactors, or biological cells, 10, 22 may be either strictly aerobic (requiring oxygen), facultative (able to function with or without oxygen), anoxic (low or no dissolved oxygen conditions), or strictly anaerobic (no dissolved oxygen). The fundamental structure of the cells is the same in all of these regimes for the purpose of PEF treatment and application. Each type of these microorganisms' cells are subject to electroporation, the development of holes in the cell wall due to the PEF electropulsing, and those cells become a food source when fed to the bioreactor. The bioreactor that receives the cells does not have to be the same type from which the microorganism cells have originated, but may be in any of these regimes, i.e., aerobic, anoxic, facultative, or anaerobic, as they may be used as food by microorganisms in any of these regimes. In addition, the PEF-treated cells may be chemotrophs or autotrophs, either or both of which are found in the different biological treatment systems. In all cases, the different types of biomass from the various bioreactors used in wastewater treatment can be treated with the PEF process, with similar electroporation of cells resulting.

While a specific embodiment of the invention has been shown and described, it is to be understood that numerous changes and modifications may be made therein without departing from the scope and spirit of the invention as set forth in the appended claims.